SUSQUEHANNA RIVER BASIN

MOSQUITO CREEK, LYCOMING COUNTY

PENNSYLVANIA

MOSQUITO RUN DAM

NDI No. PA01012

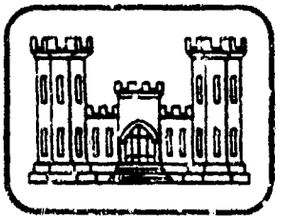
PennDER No. 41-2

Dam Owner: Williamsport Municipal Water Authority

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DACW31-81-C-0011



John A Dzinbok

prepared for

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

prepared by

MICHAEL BAKER, JR., INC.

Consulting Engineers

4301 Dutch Ridge Road

Beaver, Pennsylvania 15009

AUGUST 1981

410795

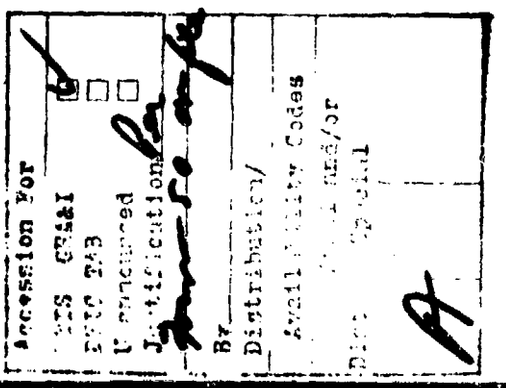
PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Mosquito Run Dam, Lycoming County, Pennsylvania
NDI No. PA 01012, PennDER 41-2
Mosquito Creek
Inspected 1 April 1981

ASSESSMENT OF GENERAL CONDITIONS

Mosquito Run Dam is owned by Williamsport Municipal Water Authority and is classified as a "Significant" hazard - "Small" size dam. The dam was found to be in good overall condition at the time of inspection.

A spillway design flood (SDF) in the range of the 100-year flood to the 1/2 Probable Maximum Flood (1/2 PMF) is required for Mosquito Run Dam. Because the dam is on the low end of the "Small" size category in terms of height and storage capacity, the 100-year flood was chosen as the SDF. Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway capacity is greater than the inflow to the impoundment during the 100-year flood. The spillway is therefore considered "Adequate."

The inspection revealed certain items of remedial work which should be performed by the owner without delay. These include:

1) Fill and seed the low area and the tire tracks on the crest of the dam.

2) Clear the debris from the spillway approach and discharge channels.

3) Provide for emergency closures on the reservoir side of all intake and outlet pipes.

4) Repair the spillway approach apron.

5) Repoint the spillway training walls.

6) Cut all trees and brush on the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded under the guidance of a qualified engineer.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rainfall, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented. These should be included in a formal maintenance and operations manual for the dam.

Submitted by:

MICHAEL BAKER, JR., INC.

John A. Dziubek, P.E.
Engineering Manager-Geotechnical

Date: 20 August 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. Peck
Colonel, Corps of Engineers
District Engineer

Date: 31 Aug 81

MOSQUITO RUN DAM

Overall View of Dike No. 2 (southeast section) and Dike No. 3 (northeast section)

Overall View of Dike No. 2 (southeast section) and Dike No. 1 (southwest section)

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APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
MOSQUITO RUN DAM
NDI No. PA 01012, PennDER No. 41-2

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Mosquito Run Dam is constructed on one side of the valley outside of the stream channel with a three-sided earthfill embankment 1201 feet long and 15.0 feet high, measured from the minimum top of dam to the toe of the embankment. The spillway is in the center of side No. 2, side No. 1 is to the right of the spillway, and side No. 3 is to the left of the spillway.[1] The embankment has a crest width of 17.5 feet and side slopes of 3.1H:1V (Horizontal to Vertical) upstream and 1.6H:1V downstream. The upstream face of the embankment is protected with riprap. A cut-off trench, consisting of clay puddle, extends down to shale, 6 to 9 feet below the original ground, and to within 1 foot of the crest. The cut-off trench extends the entire length of the embankment.

The spillway is a broad-crested weir located in the center of the embankment facing the natural stream bed. The spillway is 25 feet wide with a freeboard of 2.7 feet. Stone masonry training walls extend 3.5 feet above the crest of the weir.

A low concrete weir is constructed in the stream to divert the flow through two 24-inch pipes into

[1]Referred to as Dike No. 1, Dike No. 2, and Dike No. 3 in the photo captions.

the diversion channel which flows approximately 200 feet to the intake gatehouse. Flow into the reservoir is through two 24-inch pipes controlled by gate valves.

The outlet works consists of a brick control tower located in the reservoir with a 24-inch water supply line. A 24-inch blow-off line with a valve at the downstream toe of the embankment can be used to dewater the reservoir.

b. Location - Mosquito Run Dam is located on Mosquito Creek in Armstrong Township, Lycoming County, Pennsylvania. The dam is approximately 1.5 miles south of Duboistown in Armstrong Township. The coordinates of the dam are N 41° 12.1' and W 77° 02.8'. The dam can be cound on the USGS 7.5 minute topographic quadrangle, Williamsport, Pennsylvania.

c. Size Classification - The height of the dam is 15.0 feet. Storage at the top of the dam [elevation 721.7 feet Mean Sea Level (ft. M.S.L.)] is 64 acre-feet. The dam is therefore in the "Small" size category.

d. Hazard Classification - If the dam should fail, economic damage is likley to two homes, ranging from 4 feet to 8 feet above the streambed, 600 feet downstream from the dam. The chlorination building for the water supply is at the downstream toe of the embankment. Loss of life may occur; therefore, the dam is considered to be in the "Significant" hazard category.

e. Ownership - The dam is owned by the Williamsport Municipal Water Authority, 253 West 4th Street, Williamsport, Pennsylvania 17701.

f. Purpose of Dam - The impoundment created by the dam is used as a water supply for Williamsport and the surrounding area.

g. Design and Construction History - Mosquito Run Dam was designed and built under the supervision of Mr. W.H. Bloom in 1890, with no major modifications to the dam since that time except for a new intake tower for the water supply system.

h. Normal Operational Procedures - The reservoir is typically maintained at the spillway crest, elevation 719.0 ft. M.S.L.

1.3 PERTINENT DATA

a. Drainage Area (square miles) -	0.06
b. Discharge at Dam Site (c.f.s.) -	
Maximum Flood	Unknown
Spillway Capacity at Maximum Pool (El. 721.7 ft. M.S.L.) -	344.0
c. Elevation* [feet above Mean Sea Level (ft. M.S.L.)] -	
Design Top of Dam -	721.1
Minimum Top of Dam -	721.7
Maximum Design Pool -	Unknown
Spillway Crest -	719.0
Elevation at Toe of Dam -	706.7
Maximum Tailwater of Record -	Unknown
d. Reservoir (feet) -	
Length of Maximum Pool (El. 721.7 ft. M.S.L.) -	625.0
Length of Normal Pool (El. 719.0 ft. M.S.L.) -	610.0
e. Storage (acre-feet) -	
Top of Dam (El. 721.7 ft. M.S.L.) -	64.0
Normal Pool (El. 719.0 ft. M.S.L.) -	50.0
f. Reservoir Surface (acres) -	
Top of Dam (El. 721.7 ft. M.S.L.) -	5.3
Normal Pool (El. 719.0 ft. M.S.L.) -	4.9
g. Dam -	
Type -	Earthfill
Total Length (feet) -	1201.0
Height (feet) - Design -	10.9
Field -	15.0
Top Width (feet) -	17.5
Side Slopes - Upstream -	3.1H:1V
Downstream -	1.6H:1V

*All elevations are referenced to the spillway crest, El. 719.0 ft. M.S.L., as estimated from the USGS 7.5 minute topographic quadrangle, Williamsport, Pennsylvania.

Zoning - None
Impervious Core - None
Cut-off - Clay puddle extends entire length of embankment into shale, 6-9 feet below natural ground, to within 1 foot of the crest.
Drains - None

h. Diversion and Regulating Tunnels - None

i. Spillway -

Type - Broad-crested weir
Location - Center of embankment
Length of Crest Perpendicular to Flow (feet) - 25.0
Crest Elevation (ft. M.S.L.) - 719.0
Gates - None
Downstream Channel - Rock lined, gently sloping natural channel.

j. Outlet Works - The outlet works consists of a 24-inch water supply line and a 24-inch blow-off line with a valve at the downstream toe of the embankment.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Information reviewed for preparation of this report consisted of the Pennsylvania Department of Environmental Resources' (PennDER) File No. 41-2. This included:

1) Report to the Water Supply Commission of Pennsylvania, dated 23 February 1915, describing the reservoir and its construction.

2) A plan view of the reservoir.

3) Various inspection reports filed by the Water and Power Resources Board, 28 April 1919 through 28 October 1952. All reports state the dam is in good condition with minor maintenance needed. Some leakage is noted around the blow-off line in several of the inspection reports.

4) A permit issued by the Pennsylvania Fish Commission for drawing down the reservoir for cleaning (dated 2 November 1950).

5) The latest inspection report, dated 14 March 1966, filed by PennDER, Division of Dams and Encroachments. The report stated the reservoir to be in good condition with no deficiencies noted.

2.2 CONSTRUCTION

The dam was constructed in 1890. Mr. W.H. Bloom designed and supervised the construction of the dam.

2.3 OPERATION

No formal records are available for operation of the dam and reservoir. The spillway is uncontrolled and the reservoir is typically at the spillway crest level. The inflow into the reservior is controlled by the 2 24-inch inlet pipes at the intake gatehouse.

2.4 EVALUATION

a. Availability - The information reviewed is readily available from PennDER File No. 41-2.

b. Adequacy - The information available, combined with the visual inspection measurements and observations, is adequate for a Phase I Inspection of this dam.

c. Validity - There is no reason at the present time to doubt the validity of the available engineering data, except that a new intake and control tower was constructed in the reservoir for the water supply system.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The dam was found to be in good overall condition at the time of inspection on 1 April 1981. No unusual weather conditions were experienced during the inspection. Noteworthy deficiencies observed during the visual inspection are described briefly in the following paragraphs. The complete visual inspection checklist, field sketch, top of dam profile, and typical cross section are presented in Appendix A.

b. Embankment - Deficiencies noted are: 1) A low area on the crest of the dam approximately above the blow-off line. 2) Tire tracks on the crest along the right side of the embankment. 3) Trees and brush are growing on the upstream and downstream faces of the embankment, mostly from the spillway to the upstream right abutment.

c. Appurtenant Structures - Deficiencies noted are: 1) Debris was clogging the spillway approach. 2) The approach apron is cracked and deteriorated. 3) The spillway training walls need repointing. 4) There is a small amount of debris in the discharge channel. 5) There is no upstream closure on the upstream end of the blow-off pipe. 6) There is no valve on the reservoir end of the intake pipes.

d. Reservoir Area - The reservoir slopes are steep and no sign of instability was observed. Sedimentation is not believed to be a problem.

e. Downstream Channel - The channel is wide and well lined with rocks. The shallow channel passes through a gently sloping valley. Two homes are located 600 feet downstream from the dam. The chlorination building for the water supply is at the downstream toe of the embankment.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal procedures for operating the reservoir or evacuating the downstream area in case of an impending emergency. It is recommended that formal emergency procedures be adopted, prominently displayed and furnished to all operating personnel.

4.2 MAINTENANCE OF DAM

There are no formal records of maintenance or formal procedures for evaluating the necessity of maintenance for the structure. It is recommended that formal inspection procedures be developed.

4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance is considered adequate; however, it is recommended that a formal operation and preventive maintenance schedule be developed and implemented.

4.4 DESCRIPTION OF ANY WARNING SYSTEM

There is no warning system in the event of dam failure. It is recommended that an emergency warning system be developed.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The current operational features are adequate for the purpose they serve. However, it is recommended that a formal maintenance and operations manual be prepared for the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design calculations are available for Mosquito Run Dam.

b. Experience Data - No information concerning the effects of significant floods on the dam is available.

c. Visual Observations - During the visual inspection, no problems were observed which would indicate that the dam and appurtenant facilities could not perform satisfactorily during a flood event. Mosquito Creek is diverted into Mosquito Run Dam by a 3-foot concrete weir that has been built in Mosquito Creek to divert the flow through two 24-inch pipes, that are controlled by valves, into the diversion channel which leads to the intake gatehouse. Valves are also located in the intake gatehouse to control the flow from the diversion channel through two 24-inch pipes into the reservoir.

Mosquito Valley Reservoir, located approximately 5 miles upstream from Mosquito Run Dam, is assumed to have no effect on the dam since the flow into Mosquito Run Dam can be regulated or completely closed off.

d. Overtopping Potential - Mosquito Run Dam is a "Small" size - "Significant" hazard dam requiring evaluation for a spillway design flood (SDF) in the range of the 100-year flood to the 1/2 Probable Maximum Flood (1/2 PMF). Because the dam is on the low end of the "Small" size category in terms of height and storage capacity, the 100-year flood was chosen as the SDF.

The drainage area for Mosquito Valley Reservoir and the drainage area between the two dams were assumed to contribute no inflow into Mosquito Run Dam for these analyses. Only that drainage area observed in the field inspection that would contribute to the inflow was used for these calculations.

Using the material from "The Hydrologic Study - Tropical Storm Agnes" prepared by the Corps of Engineers in New York City, the peak inflow to the impoundment for the 100-year flood was calculated to be 171 c.f.s. The peak inflow to the impoundment

for the 100-year flood was also calculated to be 42 c.f.s., using material from "Water Resources Bulletin, Bulletin No. 13, Floods in Pennsylvania," prepared by the Department of Environmental Resources, Commonwealth of Pennsylvania. Averaging these two methods produced a peak inflow of 106 c.f.s., which was used in this analysis.

The spillway capacity at the minimum top of the dam is 344 c.f.s., which is greater than the peak inflow to the impoundment.

e. Spillway Adequacy - As outlined in the above analysis, the inflow to the impoundment during the 100-year flood is less than the spillway capacity; therefore, the spillway is considered "adequate."

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - There were no structural inadequacies noted during the visual inspection that cause concern for the continued structural stability of the dam.

b. Design and Construction Data - Calculations of slope and structural stability were not available for review. The slopes have had a history of satisfactory performance. In view of the modest height of the dam, a history of satisfactory performance of its moderate slopes, and no signs of distress observed during the visual inspection, no further stability analysis is deemed necessary.

c. Operating Records - Nothing in the operational information indicates concern relative to the structural stability of the dam.

d. Post-Construction Changes - No changes adversely affecting the structural stability of the dam have been performed.

e. Seismic Stability - The dam is located in Seismic Zone 1 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of minor seismic activity. Therefore, further consideration of the seismic stability is not warranted since the dam is considered structurally stable.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - Mosquito Run Dam was found to be in good overall condition at the time of inspection. Mosquito Run Dam is a "Significant" hazard - "Small" size dam requiring a spillway capacity in the range of the 100-year flood to the 1/2 PMF. The 100-year flood was chosen as the SDF because the dam is on the low end of the "Small" size category based on the height and storage capacity. As presented in Section 5, the spillway capacity is greater than the peak inflow from the 100-year flood. Therefore, the spillway is considered "Adequate."

b. Adequacy of Information - The information available and the observations and measurements made during the field inspection are considered sufficient for this Phase I Inspection Report.

c. Urgency - The owner should initiate the action discussed in paragraph 7.2 without delay.

d. Necessity for Additional Data/Evaluation - No further investigations are required for Mosquito Run Dam.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection revealed certain items of remedial work which should be performed by the owner without delay. These include:

1) Fill and seed the low area and the tire tracks on the crest of the dam.

2) Clear the debris from the approach and discharge channels.

3) Provide for emergency closures on the reservoir side of all intake and outlet pipes.

4) Repair the spillway approach apron.

5) Repoint the spillway training walls.

6) Cut all trees and brush on the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root

systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded under the guidance of a qualified engineer.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rainfall, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented. These should be included in a formal maintenance and operations manual for the dam.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH, TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION

Check List
Visual Inspection
Phase 1

Name of Dam Mosquito Run Dam County Lycoming State Pennsylvania Coordinates Lat. N 41°12.1'
NDI # PA 01012
PennDER # 41-2
Long. W 77°02.8'

Date of Inspection 1 April 1981 Weather Sunny Temperature 60's

Pool Elevation at Time of Inspection 719.4* M.S.L. Tailwater at Time of Inspection 713.5 M.S.L.

*All elevations are referenced to the spillway crest, El. 719.0 ft., M.S.L., as estimated from the U.S.G.S. 7.5 minute topographic quadrangle, Williamsport, Pennsylvania.

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Jeff L. Sawyer
Gary W. Todd

Owner's Representatives:

Gary W. Todd Recorder

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

EMBANKMENT

Name of Dam MOSQUITO RUN DAM

NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed	

EMBANKMENT

Name of Dam MOSQUITO RUN DAM

NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal and vertical alignment are good except for the low area noted on the Field Sketch (A-13) and top of dam profile (A-14). Minor vehicle tracks were present on the crest of the dam.	The upstream end of the embankment was constructed higher than the downstream end. Fill and seed the low area and the tire tracks on the crest of the dam.
RIPRAP FAILURES	None observed.	
VEGETATION	Brush is growing on the upstream face of the dam from the spillway to the right abutment. Trees and brush are growing on the downstream face of the dam.	Cut trees and brush on the dam and for 10 ft. below the toe of the dam.

EMBANKMENT

Name of Dam MOSQUITO RUN DAM

NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None observed	
DRAINS	None observed	

OUTLET WORKS

Name of Dam: MOSQUITO RUN DAM

NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed	
INTAKE STRUCTURE	Submerged at time of inspection.	
OUTLET STRUCTURE	The control tower with controls for the intake for the water supply line is located about 45 ft. out in the reservoir.	The control tower is in good condition.
OUTLET CHANNEL	None visible	
EMERGENCY GATE (on blow-off pipe)	Located at downstream toe of the dam. It is not known if the valve works.	Provide upstream closure for the outlet pipe. Valve should be operated to determine if it is still operable.

UNGATED SPILLWAY

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Broad-crested weir	Good condition
APPROACH CHANNEL	Debris has collected upstream from the weir. The approach apron is cracked and deteriorated.	Clear approach channel of debris. Repair the spillway approach apron. Repoint the spillway training walls.
DISCHARGE CHANNEL	Small amount of debris downstream of the weir.	Clear debris from channel.
BRIDGE AND PIERS	Wooden foot bridge across the spillway. Good condition.	

GATED SPILLWAY - Not applicable

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

INSTRUMENTATION

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER	None	

RESERVOIR

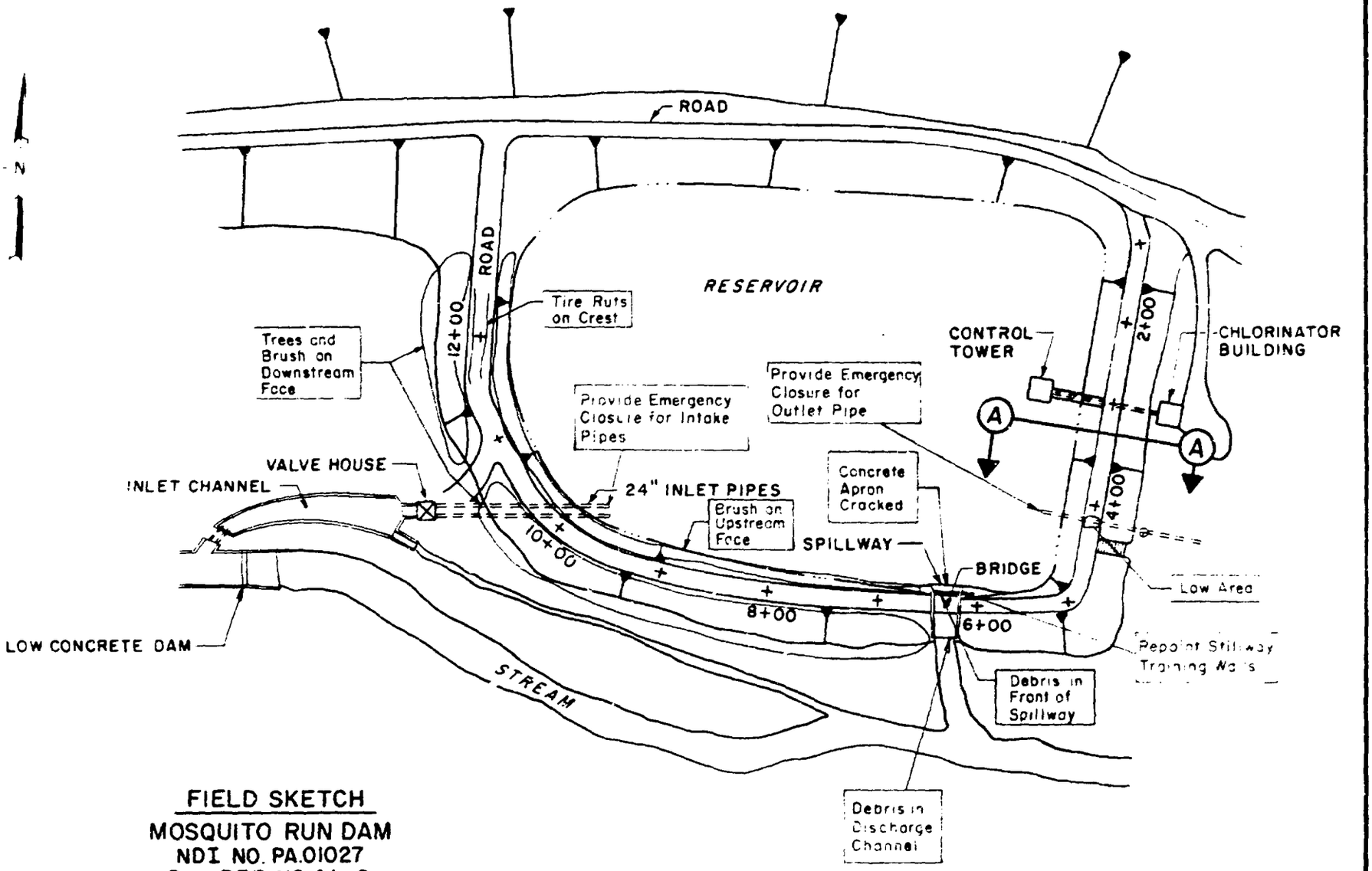
Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep slopes with good ground cover of woods.	
SEDIMENTATION	Sedimentation is not a problem.	

DOWNSTREAM CHANNEL

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Good condition	
SLOPES	Gentle slopes with good ground cover.	
APPROXIMATE NO. OF HOMES AND POPULATION	One home and one recreation building are located 400 ft. downstream of the dam from 5 ft. to 10 ft. above the stream bed. The chlorination building for the water supply is at the downstream toe of the embankment.	Economic damage is likely to both structures. Loss of life may occur.



FIELD SKETCH
MOSQUITO RUN DAM
NDI NO. PA.01027
Penn DER NO. 41-2
SCHEMATIC - NOT TO SCALE

CROSS SECTION TAKEN AT SECTION A-A

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

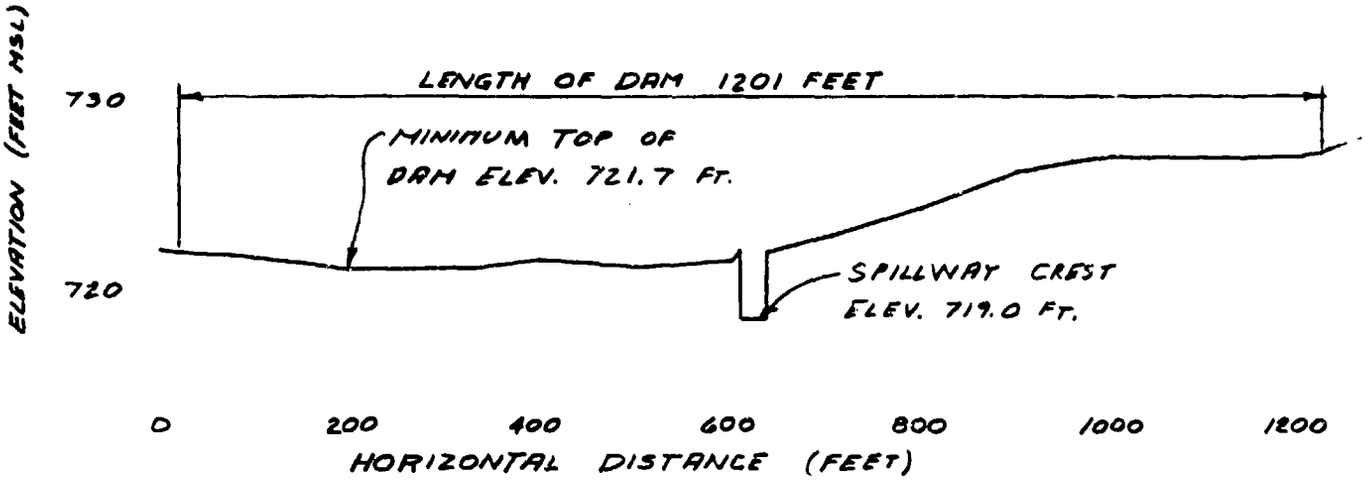
Box 280
Beaver, Pa. 15009

MOSQUITO RUN DAM

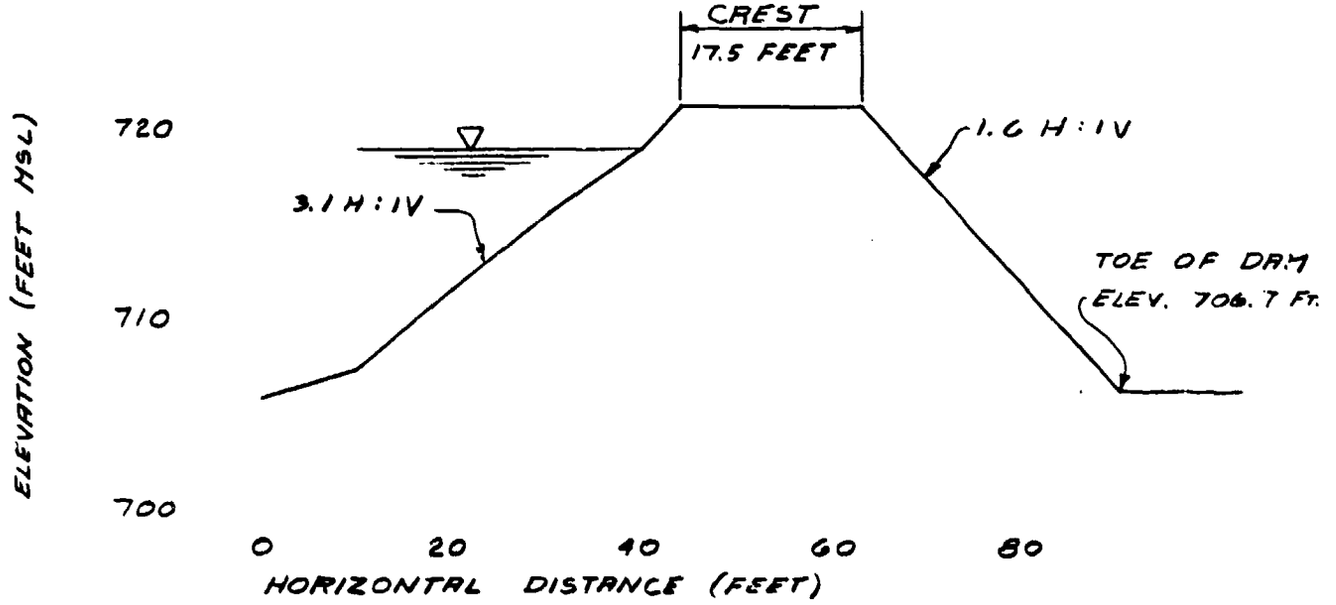
TOP OF DAM PROFILE
TYPICAL CROSS-SECTION

DATE OF INSPECTION: 1 April 1981

TOP OF DAM PROFILE (LOOKING DOWNSTREAM)



TYPICAL CROSS SECTION AT SECTION A-A



APPENDIX B

ENGINEERING DATA CHECK LIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: MOSQUITO RUN DAM

ITEM	REMARKS
PLAN OF DAM	See Plate 4 of this report.
REGIONAL VICINITY MAP	A U.S.G.S. 7.5 minute topographic quadrangle, Williamsport, Pennsylvania, was used to prepare the vicinity map which is enclosed in this report as the Location Plan (Plate 1).
CONSTRUCTION HISTORY	The dam was designed and construction supervised by Mr. W.L. Bloom. The dam was constructed in 1890.
TYPICAL SECTIONS OF DAM	See typical cross section Page A-14.
HYDROLOGIC/HYDRAULIC DATA	No information available
OUTLETS - PLAN	
- DETAILS	No information available
- CONSTRAINTS	None
- DISCHARGE RATINGS	No information available
RAINFALL/RESERVOIR RECORDS	No records are maintained.

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	No geology reports are available for the dam. See Appendix F for the Regional Geology.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available
POST-CONSTRUCTION SURVEYS OF DAM	None available
BORROW SOURCES	No information available

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	The intake tower was built after the dam was constructed.
HIGH POOL RECORDS	No information available
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	The latest inspection report, conducted on 9 March 1966, by PennDER, found the dam to be in good condition.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported in the information available.
MAINTENANCE OPERATION RECORDS	No formal records of maintenance are maintained.

Name of Dam: MOSQUITO RUN DAM
NDI # PA 01012

ITEM	REMARKS
SPILLWAY PLAN, SECTIONS, and DETAILS	See Appendix D, Sheets 4 and 5 of this report.
OPERATING EQUIPMENT PLANS & DETAILS	None available

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.06 Sq. Mi. (Primarily Forested)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 719.0 Ft. M.S.L. (50 Ac.-Ft.)

EL VATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 721.7 Ft. M.S.L. (64 Ac.-Ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 721.7 Ft. M.S.L. (Minimum Top of Dam)

SPILLWAY: Rectangular Channel

a. Crest Elevation 719.0 Ft. M.S.L.
b. Type Broad-crested weir
c. Width of Crest Parallel to Flow 0.8 Ft.
d. Length of Crest Perpendicular to Flow 25.0 Ft.
e. Location Spillover Center of Dam
f. Number and Type of Gates None

OUTLET WORKS: Water Supply Lines

a. Type 24-in.
b. Location Dike No. 3
c. Entrance Inverts Unknown
d. Exit Inverts Unknown
e. Emergency Drawdown Facilities 24-in. blow-off line

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE Unknown

APPENDIX C

PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam

Top Photo - Overall View of Dike No. 2 (southeast section) and Dike No. 3 (northeast section)
(OV-T)

Bottom Photo - Overall View of Dike No. 2 (southeast section) and Dike No. 1 (southwest section)
OV-B)

Photo Location Plan

Photo 1 - View of Dike No. 3 Crest from North Corner

Photo 2 - View of Dike No. 3 Downstream Slope from North Corner

Photo 3 - View of Dike No. 2 Crest from Northeast Corner

Photo 4 - View of Dike No. 2 Downstream Slope from Northeast Corner

Photo 5 - View of Dike No. 2 Upstream Slope from Southeast Corner

Photo 6 - View of Dike No. 2 Crest from Southeast Corner

Photo 7 - View of Dike No. 1 Upstream Slope from Southwest Corner

Photo 8 - View of Dike No. 1 Crest from Southwest Corner

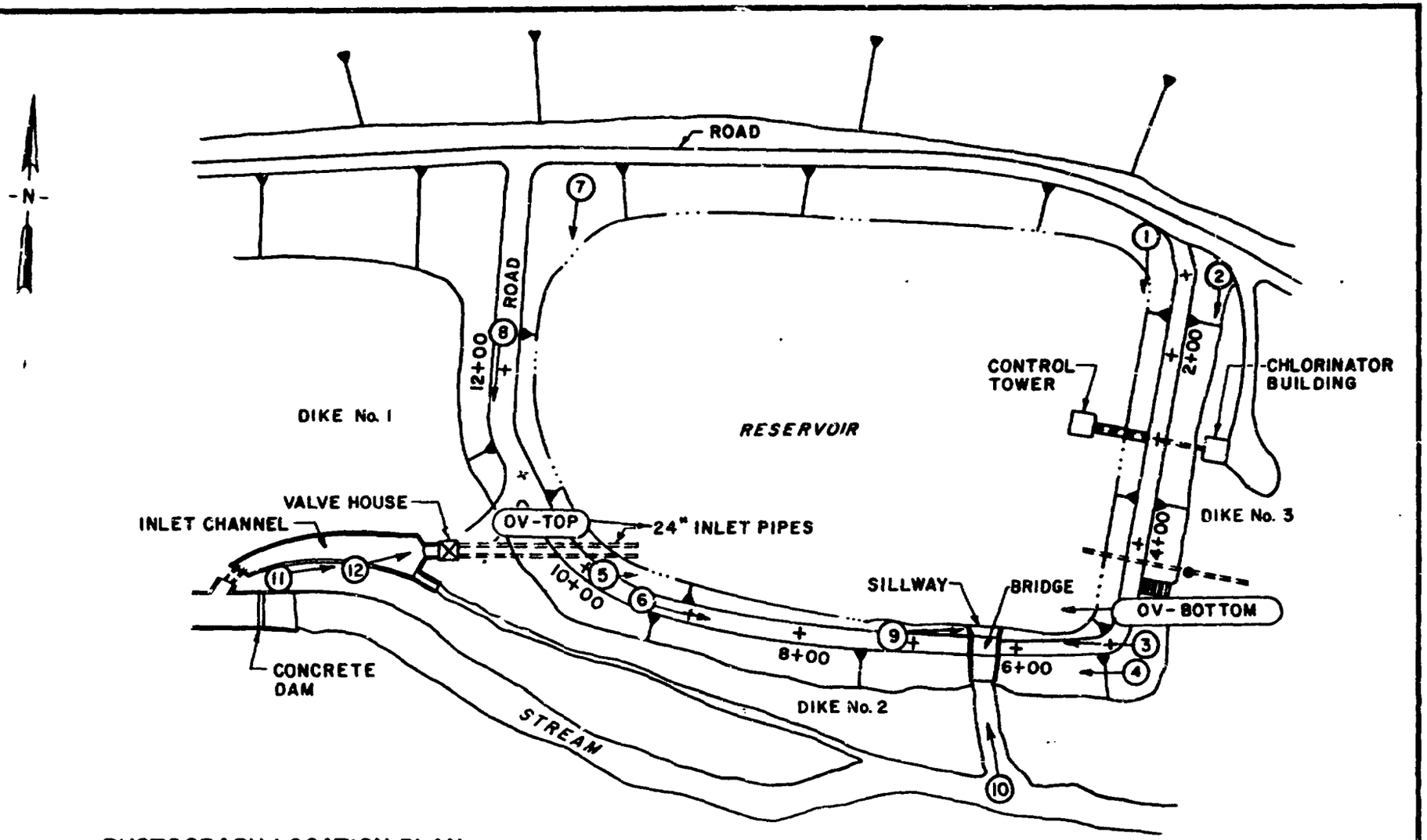
Photo 9 - View of Approach and Crest of Spillway (located at the center of Dike No. 2)

Photo 10 - View of Downstream Side of Spillway

Photo 11 - View of Diversion Channel to Reservoir

Photo 12 - View of Valve House Controlling Diversion Water to the Reservoir (Note: Dike No. 1 is located in background behind valve house)

Note: Photographs were taken on 1 April 1981.



PHOTOGRAPH LOCATION PLAN

MOSQUITO RUN DAM
NDI NO. PA.01027
PennDER NO. 41-2
Photographs Taken 1 April 1981

MOSQUITO RUN DAM

PHOTO 1. View of Dike No. 3 Crest From North Corner

PHOTO 2. View of Dike No. 3 Downstream Slope From North Corner

PHOTO 3. View of Dike No. 2 Crest From Northeast Corner

PHOTO 4. View of Dike No. 2 Downstream Slope From Northeast Corner

PHOTO 5. View of Dike No. 2 Upstream Slope From Southeast Corner

PHOTO 6. View of Dike No. 2 Crest From Southeast Corner

PHOTO 7. View of Dike No. 1 Upstream Slope From Southwest Corner

PHOTO 8. View of Dike No. 1 Crest From Southwest Corner

PHOTO 9. View of Approach and Crest of Spillway
(Located at the Center of Dike No. 2)

PHOTO 10. View of Downstream Side of Spillway

MOSQUITO RUN DAM

PHOTO 11. View of Diversion Channel to Reservoir

PHOTO 12. View of Valve House Controlling Diversion Water to the Reservoir (Note: Dike No. 1 is located in background behind valve house)

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject MOSQUITO RUN DAM S.O. No. _____
APPENDIX D- HYDROLOGIC AND Sheet No. ____ of ____
HYDRAULIC CALCULATIONS Drawing No. _____
Computed by _____ Checked by _____ Date _____

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Conclusions presented herein pertain to present conditions. The effect of future development on the hydrology of the watershed has not been considered.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Pa. Dam Insp. S.O. No.
Mosquito Run Dam Sheet No. 1 of 6
HYDRAULIC DATA Drawing No.
Computed by GBD Checked by GWT Date 3/27/81

DRAINAGE AREA

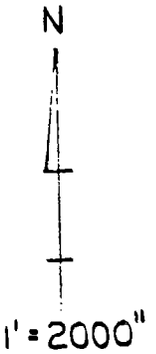
WILLIAMSPORT QUAD. - $123.97/3 = 41.32$ Acres $= 0.06 mi^2$

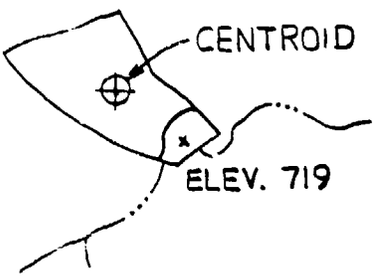
SURFACE AREAS

LAKE SURFACE @ El. 719 - $0.16/3 = .053 in^2 = 4.9$ Acres
El. 720 - $0.185/3 = .062 in^2 = 5.7$ Acres
El. 740 - $0.195/3 = .065 in^2 = 5.9$ Acres

WATERSHED LENGTHS

L = 2,300 ft. = 0.44 mi
L_{CF} 1,150 ft = 0.22 mi





WILLIAMSPORT QUAD.

MOSQUITO RUN DAM

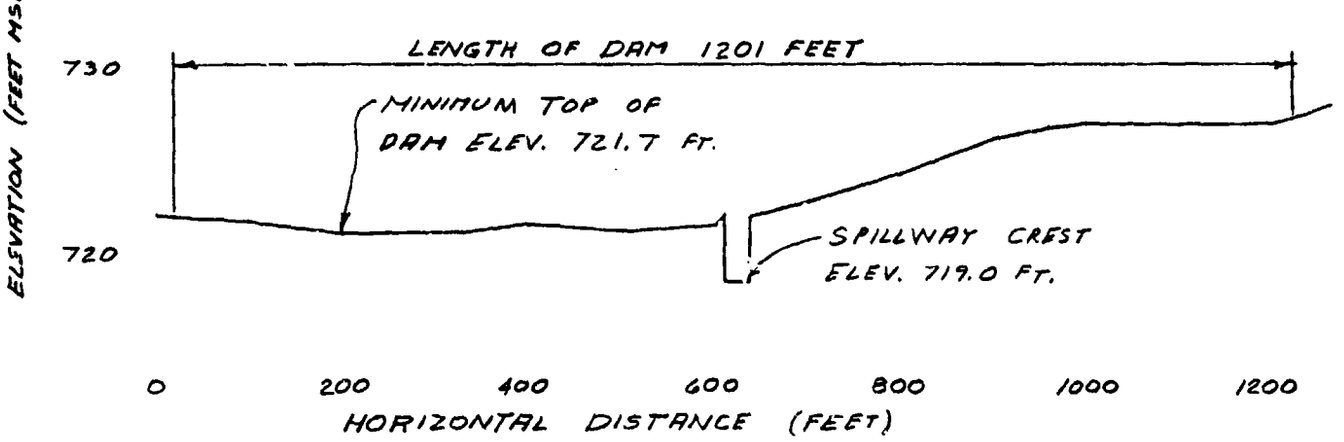
DRAINAGE AREA AND CENTROID MAP

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

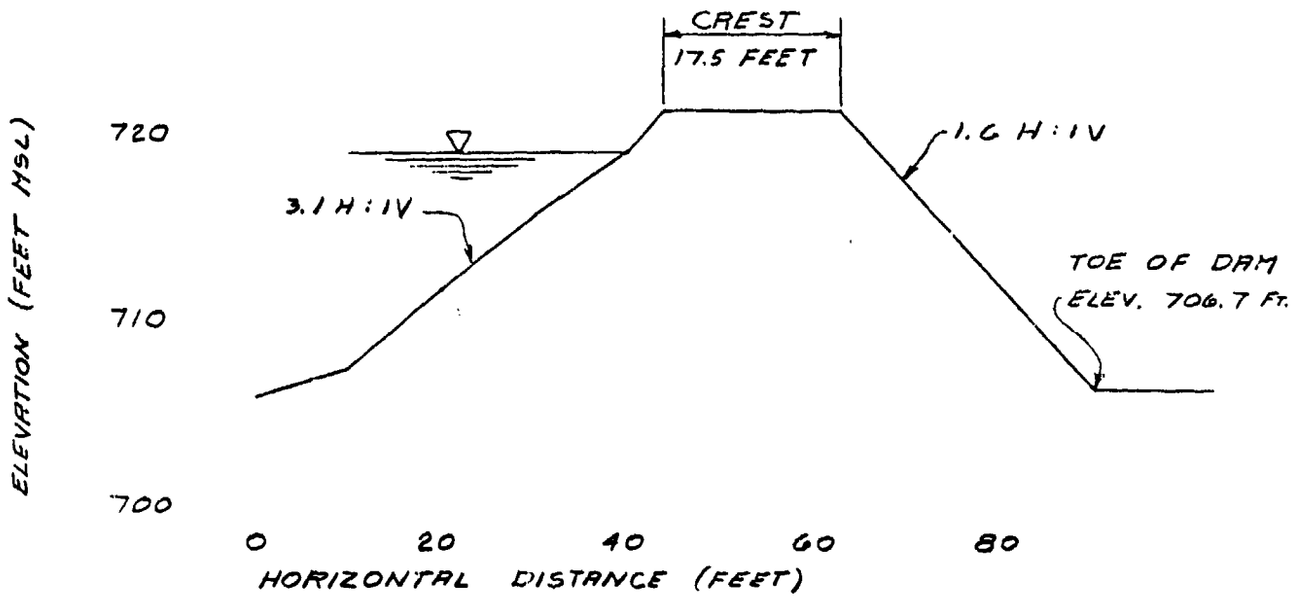
Box 280
Beaver, Pa. 15009

Subject Mosquito Run Dam S.O. No.
Top of Dam Profile and Sheet No. 3 of 6
Typical Cross Section Drawing No.
Computed by GWT Checked by WDV Date 4/3/81

Top of Dam Profile (Looking Downstream)



Typical Cross Section at Section A-A



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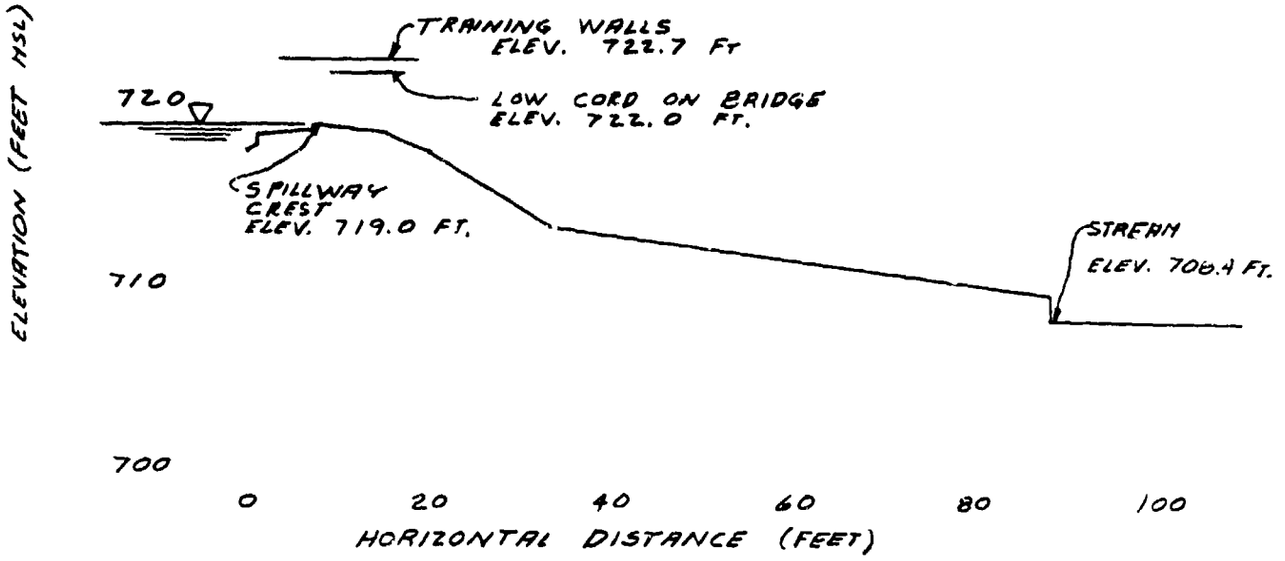
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject MOSQUITO RUN DAM S.O. No.
SPILLWAY DISCHARGE RATING Sheet No. 4 of 6
Drawing No.
Computed by GWT Checked by WDL Date 4/6/81

SPILLWAY PROFILE



SPILLWAY DISCHARGE RATING

BROAD-CRESTED WEIR
$L = 25.0$ FT.
WIDTH = 0.8 FT.

$Q = CLH^{3/2}$

$C = 3.1$ FROM TABLE 5-3, Pg. 5-40

$L = 25.0$ FEET

$H = 2.7$ FEET TO MINIMUM TOP OF DAM

$Q = 3.1 \times 25.0 \times 2.7^{1.5}$

$Q = 344$ C.F.S.

THE MAXIMUM SPILLWAY CAPACITY OF THE SPILLWAY IS 344 C.F.S. BEFORE OVERTOPPING THE DAM.

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THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject MOSQUITO RUN DAM S.O. No.
100-YEAR DISCHARGE CALCULATION Sheet No. 5 of 6
Drawing No.
Computed by GWT Checked by WDL Date 4/7/81

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "THE HYDROLOGIC STUDY - TROPICAL STORM AGNES" PREPARED BY THE SPECIAL STUDIES BRANCH, PLANNING DIVISION, NORTH ATLANTIC DIVISION, CORPS OF ENGINEERS, IN NEW YORK CITY.

DRAINAGE AREA - 0.06 Sq. Mi.

① COMPUTE THE MEAN LOGARITHM

$\log(Q_m) = C_m + 0.75 \log A$

$\log(Q_m)$ = MEAN LOGARITHM OF ANNUAL FLOOD PEAKS
A = DRAINAGE AREA, SQ. MI. - 0.06
C_m = MAP COEFFICIENTS FOR MEAN LOG OF ANNUAL PEAKS FROM FIG. 21 - 2.03

$\log(Q_m) = 2.03 + 0.75 (\log 0.06)$
$= 1.1136$

② COMPUTE STANDARD DEVIATION

$S = C_s - 0.05 (\log A)$

S = STANDARD DEVIATION OF THE LOGARITHMS OF THE ANNUAL PEAKS.
C_s = MAP COEFFICIENT FOR STANDARD DEVIATION FROM FIG. 22 = 0.36
A = DRAINAGE AREA, SQ. MI., = 0.06

$S = 0.36 - 0.05 (\log 0.06)$
$= 0.4211$

③ SELECT SKEW COEFFICIENT FROM FIG. 23 = 0.45

④ $\log(Q_{100}) = \log(Q_m) + K(P,g) S$

K(P,g) = STANDARD DEVIATE FOR A GIVEN EXCEEDENCE FREQUENCY PERCENTAGE (P) AND SKEW COEFFICIENT (g) FROM EXHIBIT 39 OF BEARD'S "STATISTICAL METHODS IN HYDROLOGY" 2.657

$\log(Q_{100}) = 1.1136 + 2.657 (0.4211)$
$Q_{100} = 171$ C.F.S.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject: Mosquito Run Dam S.O. No.
100-YEAR Discharge Calculation Sheet No. 5 of 6
Drawing No.
Computed by GWT Checked by WDV Date 7/27/81

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "WATER RESOURCES BULLETIN, BULLETIN NO. 13, FLOODS IN PENNSYLVANIA", PREPARED BY THE DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA.

DRAINAGE BASIN FROM PLATE 1 – MODEL 5

REGRESSION EQUATION FROM TABLE 5

$Q_T = CA^X P_i^P$

T = 100 YEARS
C = 42.2
A = DRAINAGE AREA, 0.06 Sq. Mi.
X = .751
P_i = 42.0 – 25.2 = 16.8
P = .744

$Q_{100} = 42.2\ (0.06)^{.751} (16.8)^{.744}$

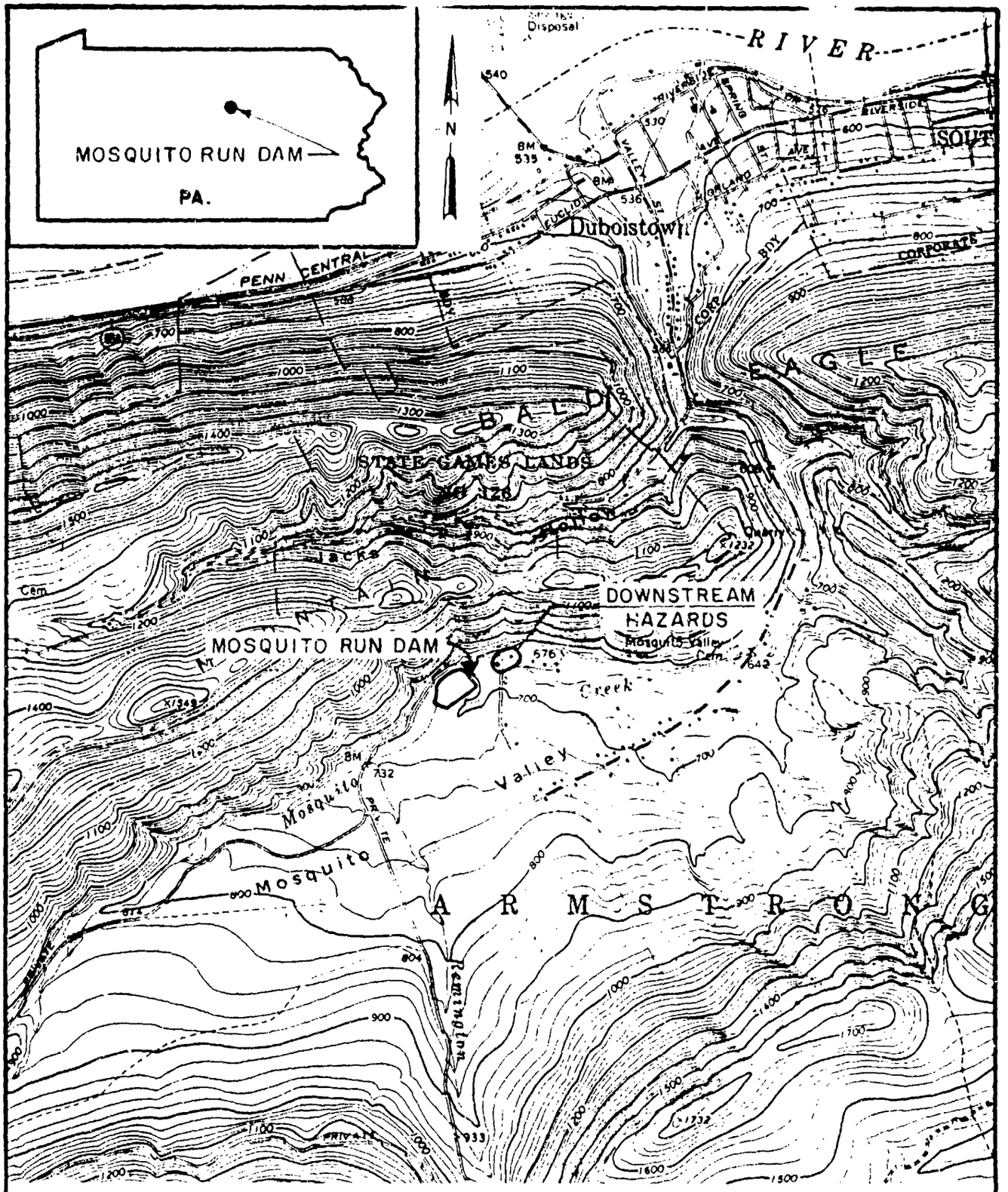
Q_{100} = 41.6 C.F.S.

AVERAGING THE FLOW FROM THIS METHOD AND THE PREVIOUS METHOD PRODUCED A PEAK INFLOW TO THE IMPOUNDMENT OF 106 C.F.S.

APPENDIX E

PLATES

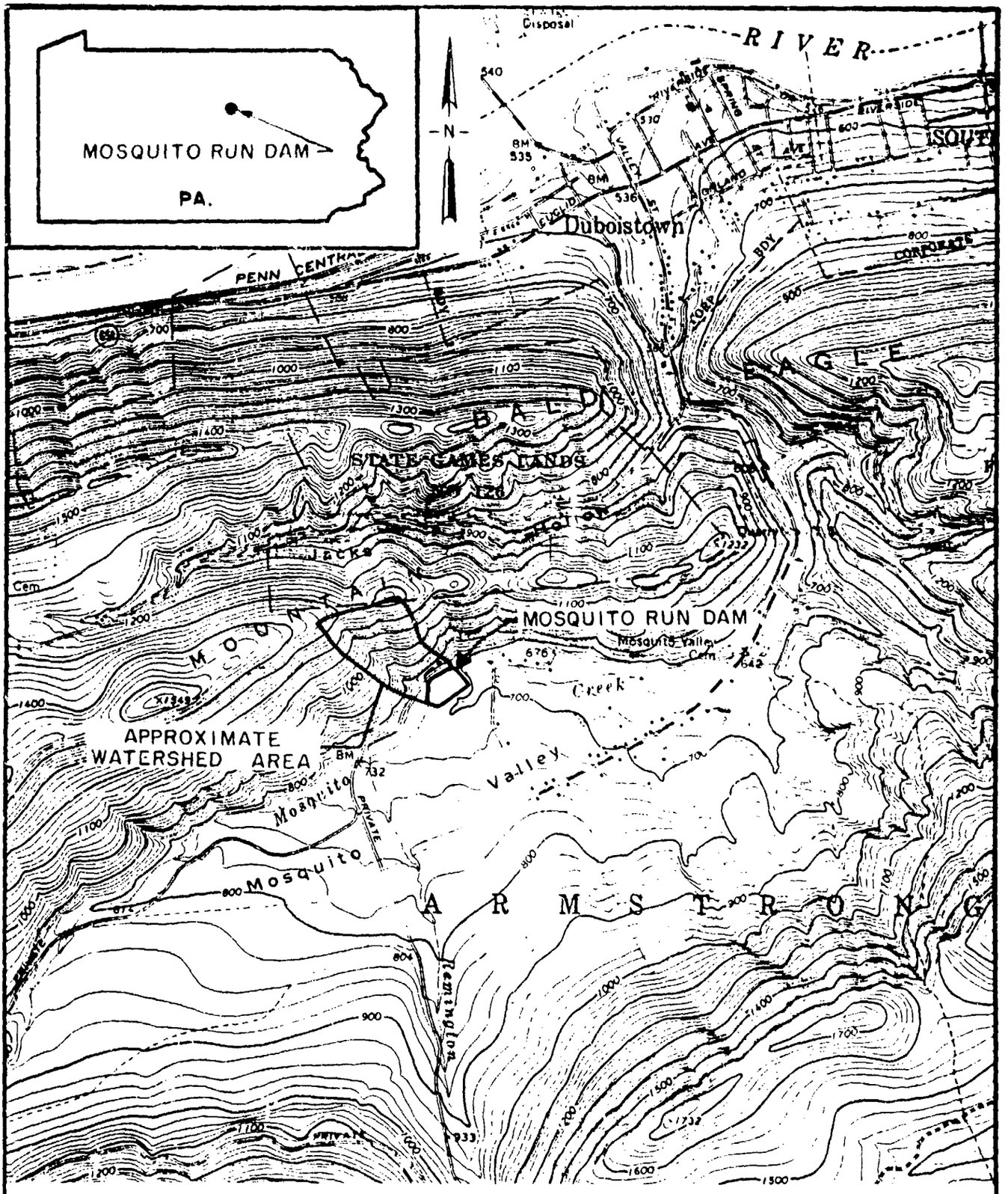
CONTENTS



REFERENCES:
1. U.S.G.S. 7.5' WILLIAMSPORT, PA. QUADRANGLE. PHOTOREVISED 1973

PLATE 1 LOCATION PLAN

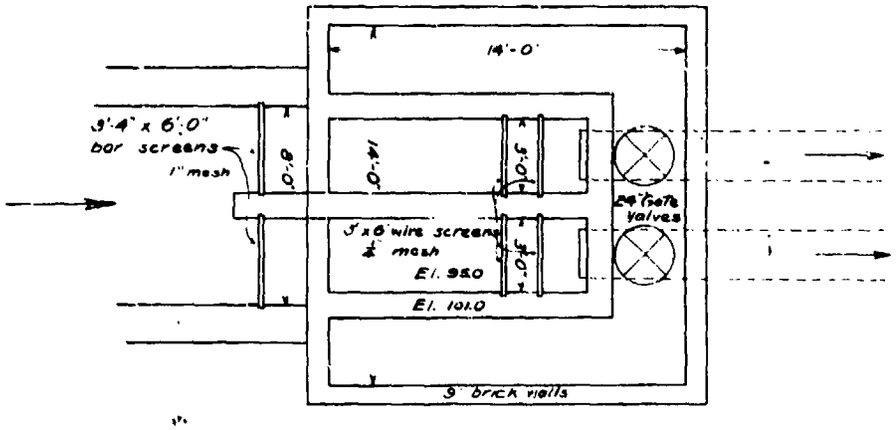
MOSQUITO RUN DAM



REFERENCES:
1. U.S.G.S. 7.5' WILLIAMSPORT, PA. QUADRANGLE. PHOTOREVISED 1973

PLATE 2 WATERSHED MAP

MOSQUITO RUN DAM



DETAIL
of
SCREEN AND GATE HOUSE
Scale 1/4" = 1'

WILLIAMSPORT WATER COMPANY

PLAN OF

MOSQUITO VALLEY RESERVOIR

Scale – 1" = 40'

F. H. SHAW, CONS. ENGR
LANCASTER PA.

SEPT 1912

PLATE 3

Note: Elevations from assumed base.

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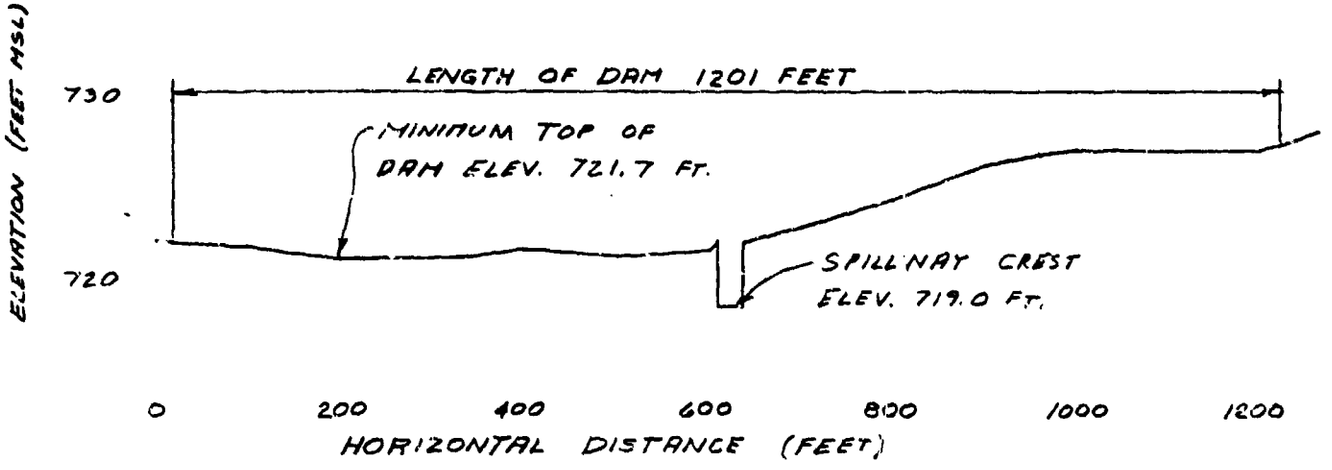
Box 280
Beaver, Pa. 15009

Subject Mosquito Run Dam S.O. No.
Top of Dam Profile and Sheet No. 3 of 6
Typical Cross Section Drawing No.
Computed by GWT Checked by WDL Date 4/3/81

Top of Dam Profile (Looking Downstream)



Typical Cross Section at Section A-A

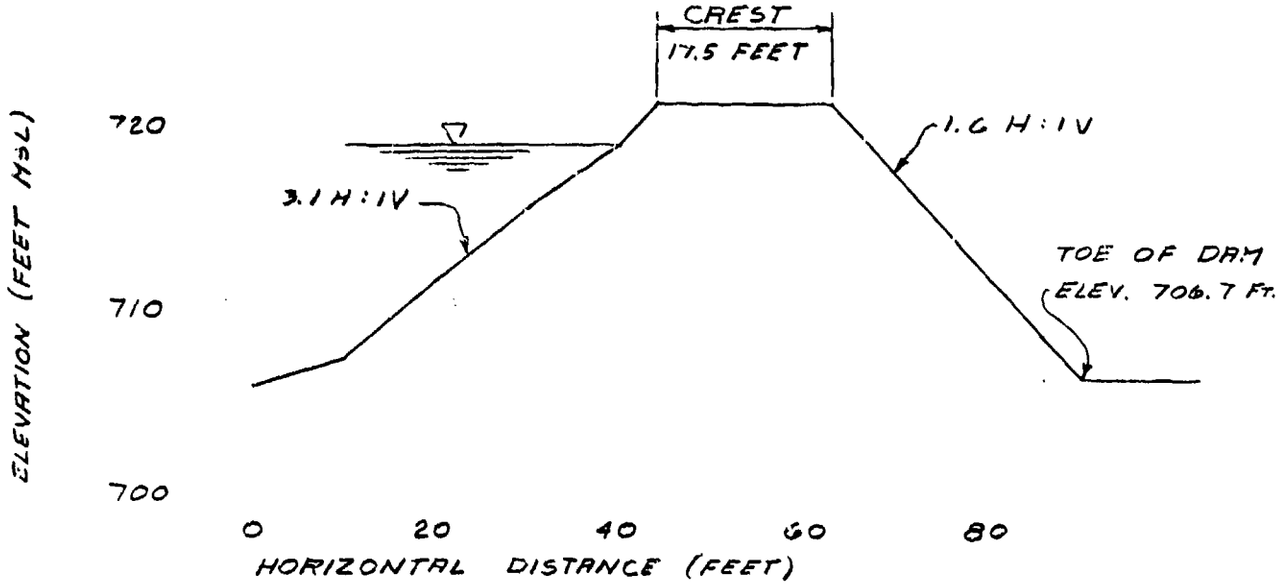


PLATE 4

APPENDIX F

REGIONAL GEOLOGY

Mosquito Run Dam
NDI No. PA 01012, PennDER No. 41-2

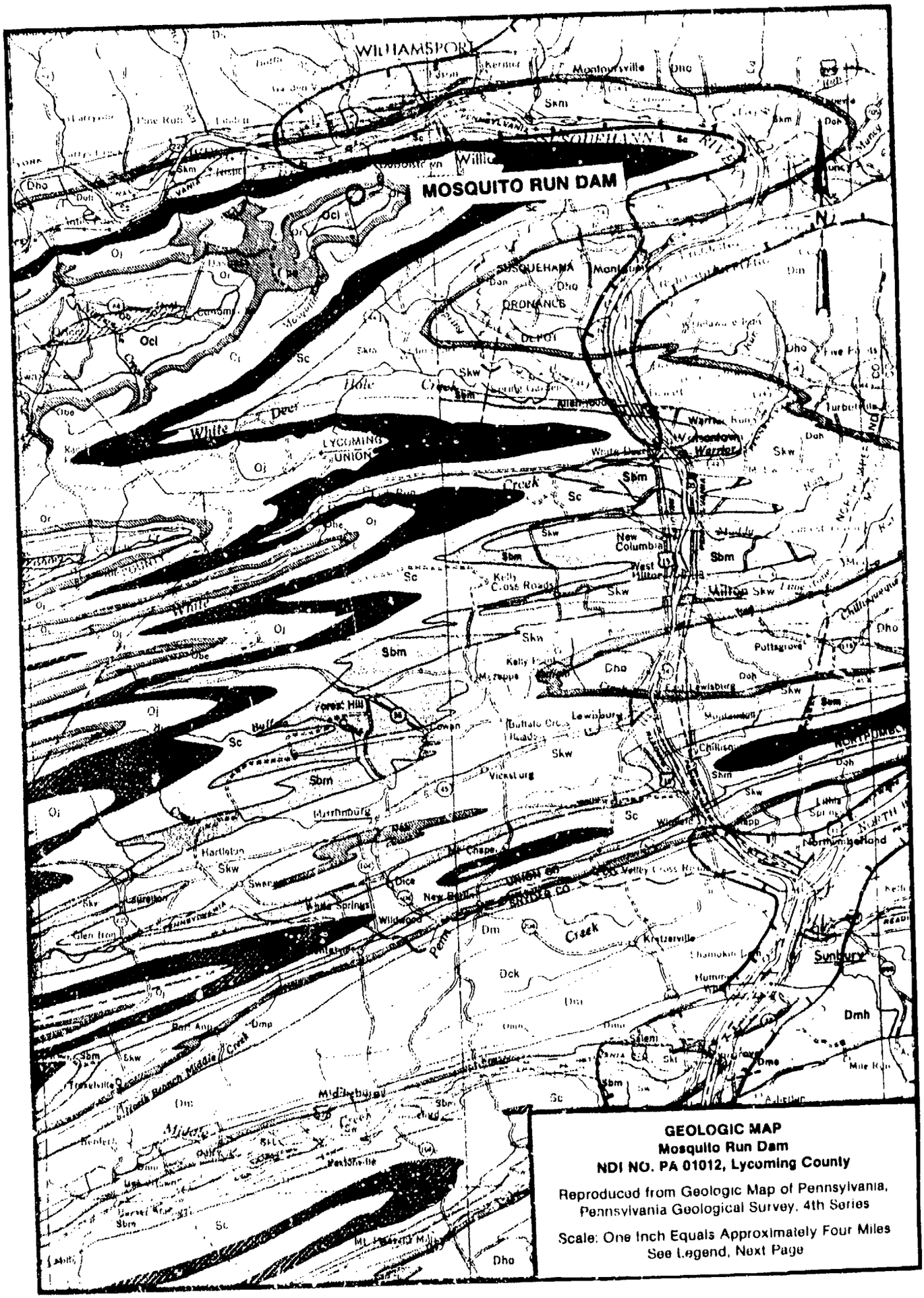
REGIONAL GEOLOGY

The Mosquito Run Dam is located in the Appalachian Mountain section of the Valley and Ridge physiographic province. The impounded lake occupies the Mosquito Valley south of the confluence of Mosquito Creek and Remington Run. Water discharging from the lake flows north through Duboistown to form a confluence with the Susquehanna River. The average topographic relief from Jacks Mountain to the Susquehanna River Valley is 950 feet.

The study area is characterized by a series of well defined anticlines and synclines that are expressed topographically as long linear shaped ridges and broad irregular shaped valleys. No boring log information was available for review, thus the extent and thickness of the soil types is difficult to ascertain. According to the Soils Conservation Survey for Lycoming County, the soils in the vicinity of the lake consist of Weikert Series to the northwest, the Holly Series to the northeast, and the Shelmadine Series to the east and south. The Weikert Series consists of shallow, well drained soils on uplands. They formed in material weathered from shale, siltstone, and sandstone. These soils typically range from dark brown shaly silt loam near the surface to yellowish brown very shaly silt loam at a depth of 18 inches. The Holly Series consists of deep, very poorly drained soils formed in loamy alluvium on flood plains. The surface layer is dark grayish brown silt loam. The subsoil is dark gray silt loam to gray sandy loam. The substratum is dark gray sandy loam to greenish gray gravely sand. The Shelmadine Series consist of deep, poorly drained soils on the uplands and were formed in glacial till. These soils have a dark grayish brown very stony silt loam surface layer. The subsoil is light brownish gray silty clay loam. A firm and brittle fragipan is between 22 and 46 inches deep. It is dark yellowish brown channery silty clay loam in the upper part and dark grayish brown channery loam in the lower part. The substratum is dark brown channery loam.

Geologic data taken from the Geologic Map of Pennsylvania indicates that the bedrock in the vicinity of the lake is composed of Ordovician rocks belonging to the Bald Eagle, Reedsville and Curtin Formations. The Bald Eagle Formation is a gray to greenish gray, fine grained to conglomeratic, thick bedded sandstone. The Reedsville Formation is a dark gray, olive weathering shale with thin silty to sandy interbeds and a black shale at the base. In the vicinity of the lake,

the Curtin Formation is undifferentiated. In other parts of the state, this formation has been subdivided into as many as six (6) different formations. In the study area, the formation consists of a gray impure limestone; bluish gray fine grained, high calcium limestone with some larger calcite grains.



GEOLOGIC MAP
Mosquito Run Dam
NDI NO. PA 01012, Lycoming County

Reproduced from Geologic Map of Pennsylvania, Pennsylvania Geological Survey, 4th Series

Scale: One Inch Equals Approximately Four Miles
See Legend, Next Page

GEOLOGY MAP LEGEND

SILURIAN

Skt

Keyser Formation

Dark gray, highly fossiliferous thick bedded crystalline to nodular limestone, passes into Mandata, Rondout, and Becker Formations to the east

Skw

Tonoloway Formation

Gray, highly laminated, thin bedded, argillaceous limestone, passes into Bossardville and Vozoo Island beds to the east

Sw

Wills Creek Formation

Greenish gray, thin bedded, fissile shale with local limestone and sandstone zones, calcitic calc shale and siltstone in the lower part.

Skm

Bloomsburg Formation

Red, thin and thick bedded shale and siltstone with local units of sandstone and thin impure limestone, some green shale in places

McKenzie Formation

Greenish gray, thin bedded shale interbedded with gray, thin bedded, fossiliferous limestone; shale predominant at the base; intraformational breccia in the lower part. Absent in Harrisburg quadrangle and to the east.

Sc

Clinton Group

Predominantly Rose Hill Formation - Reddish purple to greenish gray, thin to medium bedded, fossiliferous shale with interfingering "iron sandstones" and local gray, fossiliferous limestone above the Rose Hill is brown to white quartzitic sandstone (Keefer) interbedded upward with dark gray shale (Rochester)

Tuscarora Formation

White to gray, medium to thick bedded, fine grained, quartzitic sandstone, conglomeratic in part

Shawangunk Formation

Light gray to tan, thick bedded, impure quartzitic sandstone and conglomerate with thin shale interbeds eastern Pennsylvania only

OS

Undifferentiated Ordovician and Silurian rocks

In fault slices only

GEOLOGY MAP LEGEND

ORDOVICIAN

CENTRAL PENNSYLVANIA

Ot

Juniata Formation
Red, fine grained to conglomeratic, quartzitic sandstone with well developed cross-bedding and with interbedded red shale in places.

Bald Eagle Formation
Gray to greenish gray, fine grained to conglomeratic thick bedded sandstone; often iron-speckled and cross-bedded; some greenish gray shale in places.

Or

Reedsville Formation
Dark gray, olive weathering shale with thin silty to sandy interbeds, black shale of Antes Formation at the base.

Coburn Formation
Dark gray to black, thin bedded limestone with black shale interbeds.

Salona Formation
Dark gray, thin bedded, dense limestone

Nealmont Formation
Bluish gray, finely crystalline, fossiliferous limestone; lower part grades laterally into Curtin Formation.

Curtin Formation
Gray, impure limestone; bluish gray, fine grained, high calcium limestone with some larger calcite grains (Valentine Member, Ovl) at the top.

Ovl

Benner Formation
Gray, mottled, dolomitic limestone and coarse granular limestone.

Hatter Formation
Dark gray, impure, fossiliferous limestone.

Loysburg Formation
Dense limestone over irregularly banded dolomitic limestone.

Bellefonte Formation
Gray, cream to tan weathering, medium bedded dense dolomite.

Axemann Formation
Bluish gray, medium bedded, impure limestone.

Nittany Formation
Gray, thick bedded, coarsely crystalline dolomite

Os

Stonehenge-Larke Formation
Stonehenge: Bluish gray, finely crystalline limestone and dark gray, laminated limestone with abundant "edgewise" conglomerate. Larke: Dark, coarsely crystalline dolomite equivalent to Stonehenge

Ons

Beekmantown Group

GREAT VALLEY

Oms | Omh | Om

Martinsburg Formation
Gray to dark gray, light gray to olive weathering shale Om with thick sandstone interbeds Oms; east of Susquehanna River contains interbedded red shale, gray to brown sandstone and thin bedded limestone Oms; has associated andesite lavas Ome in Lebanon County.

Chambersburg Formation
Dark gray, thin bedded limestone (Oranda) at the top; gray, argillaceous limestone (Mercersburg) in the middle; dark gray, cobbly and thin, irregularly bedded limestone (Shippensburg) below. Occurs southwest of Susquehanna River only.

Hershey and Myerstown Formations
Hershey: Dark gray to black, thin bedded, argillaceous limestone. Myerstown: Medium to dark gray, platy, medium crystalline limestone, carbonaceous at base. Unit also called Jacksonburg in eastern Pennsylvania.

Osp | Oan

St. Paul Group and Annville Formation
Buff colored, even grained, magnesian limestone containing numerous layers of blocky chert. Annville Formation (upper St. Paul Gr.): light gray, massive, high calcium limestone, mottled at base; east of Susquehanna River

Ontelaunee Formation
Light to dark gray, very fine to medium crystalline dolomite with interbeds of bluish gray limestone, interbedded and nodular dark gray chert at base

Oe

Epler Formation
Very fine crystalline, bluish gray limestone interbedded with gray dolomite, coarse crystalline limestone lenses present.

Rickenbach Formation
Gray, very fine to coarse crystalline, laminated dolomite, dark gray chert in irregular beds, stringers, and nodules, bands of quartz sand grains in lower half.

Os

Stonehenge Formation
Gray, fine crystalline limestone and dark gray laminated limestone with numerous "edgewise" conglomerate beds.

PIEDMONT

Diabase

Ocb

Cocalico Formation
Gray shale, highly phyllitic in places; some interbedded red shale and argillaceous and graywacke sandstone.

Ocs

Conestoga Formation
Bluish gray [illegible] Chester Valley [illegible]